From Jim Buell
7/14/99

GROUP

This version of B.J.'s writing reflects my notes/recollection of changes we dealt with during our meeting of 13 July. Both my notes and my recollection are bound to be faulty, so apologies in advance.

I also propose certain changes we did NOT deal with on the 13th. Both kinds of changes are represented here in *italics* for insertions and ~~strikeout~~ for removals; comments or rationales are in [brackets].

Buell

DRAFT
HYPOTHESES FOR TECHNICAL GROUPS
July 10, 1999

The technical groups should address each of the following specific hypotheses and report on the *level of scientific support for* ~~correctness of~~ each. The hypotheses are important because they form the basis underlying operational changes and other actions undertaken during the EWA games. These reports should state the circumstances under which the hypothesis is *scientifically supported* ~~correct~~, the circumstances under which *scientific evidence is contrary to the hypothesis and circumstances under which there is insufficient scientific evidence to form a supportable conclusion* ~~it is not~~. *The reports should present* ~~and~~ the reasons for these conclusions. The reports should state what the important uncertainties are and should recommend how these uncertainties could be resolved. The technical groups should perform new analyses if necessary and feasible for their mission. They should also invite presentations by non-group members who have special expertise or who have developed analyses relevant to the hypothesis under discussion.

The Technical Groups should conduct their review in an iterative fashion. That is, they should attempt to produce early, preliminary conclusions that could subsequently be refined as more analyses are available.

The phrase "important to the population" as used below should be addressed by quantifying the population effect whenever possible.

The intent of this process is to produce analyses and conclusions, along with backup material, that would withstand independent scientific review consistent with that normally applied to professional journals. *[Is the bar too high here? I understand the desire to apply some scientific standard here, but a "professional journal" standard may not be practical for this exercise. On the other hand, just trotting out a bunch of correlations won't' do. We will need solid, connected reasoning and rational, supportable mechanisms.]*

NEXT STEPS

Agree on a list of hypotheses

Expand this list by including specific questions to be answered for each specific hypothesis

Annotate the expanded list by identifying analyses and information that would be relevant to answering each question (that is, give the teams a head start).

Decide how the analyses and information will be prepared (responsibility, schedule, budget).

Identify the members of the Technical Teams (could vary for each hypothesis).

Describe the process by which the teams conduct their evaluations.

HYPOTHESES

Six general hypotheses (A-F) are listed below. Each is followed by specific hypotheses. Each specific hypothesis will be further expanded by a series of questions to ensure that the meaning of the hypothesis is clear. The last general hypothesis is followed by a description of work to be done by technical teams to put the effects of water project actions in the Delta in perspective.

A. DIRECT EXPORT MORTALITY: Direct export mortality is mortality occurring within export facilities. It can be categorized as follows:

Pre-screen predation (in Clifton Court Forebay at the Banks Pumping Plant, at and near the trash booms at the Tracy Pumping Plant)

Screening mortality (fish dying at or passing through the screens)

Salvage and handling mortality

Post release predation (abnormally high predation rates at sites where salvaged fish are released).

General Hypothesis: Direct export mortality is affected by export rates and has important population effects.

Specific Hypotheses

A1. Changes in exports to reduce salvage have an important net effect on populations of chinook salmon, delta smelt, striped bass, and splittail ("net" refers to the possibility that exports might be reduced at one time of the year and increased at another). This The importance of this effect depends on a number of factors, ~~including~~ *such as*:

- The overall abundance of the species or race, with importance being inversely related to population abundance.
- The age of the fish being entrained, with importance increasing with age.
- *The efficiency [or effectiveness] of fish separation [or screening], salvage and re-introduction operations, with importance increasing as efficiency decreases.*
- *The distribution of populations, with importance increasing with the proximity of centers of distribution to the pumps.*

~~A2. The rate of exports affects the number of fish exposed to and entering export facilities and, therefore, the number of fish salvaged and magnitude of direct export mortality.~~

[Former A3 moved to "C2"]

~~A4.~~ *A2* Adult equivalent direct mortality is a better measure of export effects on population than either salvage or direct mortality.

A3. ~~However, a~~ Adult equivalent direct mortality for delta smelt cannot now be estimated with enough accuracy to be useful.

~~A5. Curtailing exports during times of out-migration of San Joaquin River smolts results in a decrease in exposure to CCFB and screening/salvage operations and therefore an increase in survival of out-migrating smolts, and this increase has an important effect on population.~~ *[NOTE: I would have changed the wording of this by adding the italicized portion and would have kept this hypothesis in...that's not what the group wanted, however.]*

B. INTERIOR DELTA MORTALITY:

Interior Delta mortality is mortality occurring in the Delta, primarily the central and southern Delta, and not within the export facilities. Causes of interior Delta mortality include predation, food limitation, toxicity, water temperature, and, indirectly, the quality and abundance of *beneficial physical* habitat *features*.

General Hypothesis: Exposure *of a significant proportion of a population* to *the* interior Delta ~~mortality~~ affects levels of interior Delta mortality. This exposure is ~~associated with~~ *modified by* export pumping rates *through some mechanism*; the higher the export rate, the greater the *proportion of the population exposed to the interior delta and the more significant the increase in* interior Delta mortality. Interior Delta mortality has important population effects as do the project-induced changes in interior Delta mortality attributed to export pumping.

Specific Hypotheses

B1. Interior Delta mortality (mortality not occurring within export pumping facilities) in the central and southern Delta is important to population levels of life stage recruitment rates for various fish species.

B2. Increased exports are associated with higher levels of *exposure to the* interior Delta *and associated elevated* mortality and these higher levels have important effects on population of several species of fish.

B3. Probable future changes in conditions (physical habitat features, predation, food supply, etc.) affecting interior Delta mortality *rates* will significantly diminish the importance of exports on interior Delta mortality.

C. ABUNDANCE AND OUTFLOW OR WESTERN DELTA SALINITY:

Relationships have been found between annual abundance of selected estuarine species and Delta outflow or western Delta salinity.

General Hypothesis: Annual abundance of estuarine species increases with lower levels of western Delta salinity in the spring (generally, February through June).

Specific Hypotheses

C1. There is an inverse relationship between X2 and abundance of several estuarine species; that is, the lower the value of X2, the higher the abundance.

C2. Changes in X2 that can be achieved by managing water project operations cause changes in populations that are important. *[I think it is important to separate "C1" into two hypotheses, since one could accept one idea as true but not the other.]*

~~A3.~~ ~~C2~~. *C3.* Lower values of X2 result in delta smelt being farther downstream, which results in lower exposure to facilities and therefore lower mortality at the export pumps, and this lower mortality has an important positive effect on population.

D. BARRIERS:

The Delta Cross channel gates ~~are~~ *is* one barrier. Other barriers have been proposed or built in the southern Delta, including a barrier at the head of Old River and one in Grant Line Canal. These barriers limit the movement of water and fish.

General Hypothesis: Closing or installing barriers has positive effects on population levels of some fish (primarily salmon) and negative effects on other fish (primarily delta smelt).

[I think a better way of stating this general hypothesis is "Closing or installing barriers has population-level impacts on fish, with the nature of the effect (positive or negative) varying with the species and life stage." Other opinions?]

Specific Hypotheses

D1. Closing the barrier at the Head of Old River during times of out-migration of San Joaquin River salmon smolts results in an *altered distribution and migration route for these fish and therefore an* increase in survival ~~of outmigrating smolts~~, and this increase has an important effect on population.

D2. Barrier operations in the South Delta result in *an altered distribution and migration route for delta smelt and therefore* an increase in mortality of ~~delta smelt~~ *this species* at the export pumps *(direct mortality)* and in the southern Delta *(indirect mortality)*. ~~and these~~ *This* increases ~~have~~ *has an* important effects on *the* population.

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D3. Closing the Delta Cross Channel gates whenever significant numbers of young chinook salmon are migrating past the Cross Channel will have important positive effects on the population of chinook salmon.

D4. Closing the Delta Cross Channel gates whenever significant numbers of chinook salmon are migrating past the Cross Channel will have ~~and~~ important negative effects on the population of delta smelt (by restricting their downstream movement).

[I feel very strongly that "D3" needs to be separated into two hypotheses, since it is quite possible to accept one hypothesis and not the other. In addition, separating these two ideas highlights the tradeoff, which is important to do.]

E. OTHER WATER PROJECT-RELATED REQUIREMENTS:

Several other prescriptive requirements control water project operations in the Delta.

General Hypothesis: These prescriptive requirements have good *cause-effect* relationships with population level effects, and are ~~superior in this regard to~~ *more efficient than* flexible, real time requirements *in controlling population-limiting project-induced mortalities for target species and life stages. [I feel strongly that these are very important changes!]*

Specific Hypotheses

E1. The export/inflow ratio has good relationships with abundance or mortality at the export pumps and is, therefore, a good way to control exports to reduce population level effects.

E2. Increasing flows in the San Joaquin River during times of outmigration of San Joaquin River salmon smolts results in an increase in survival of smolts, and this increase has an important effect on population.

E3. Higher levels of flow in the Sacramento River results in higher levels of survival of outmigrating salmon and early life stages of striped bass, and these higher levels of survival have an important effect on population.

E4. Mortality of resident and migrating fish at the export pumps (direct export mortality) varies inversely with net calculated flow (QWEST) in the lower San Joaquin River ~~is~~ *which governs distributions of fishes*, and this variation has important effects on population.

E5. ~~Survival~~ *Mortality* of outmigrating salmon is higher the ~~higher~~ *lower* QWEST is *(indirect delta mortality)*, and this higher ~~survival~~ *mortality* has an important effect on population. *[This hypothesis is not good the way it is, and is probably not testable. It needs a plausible mechanism! This has always been the trouble with Q-West, but there should be some hypothesis to cover the concept. Perhaps appealing to a "distribution effect" somewhere in the hypothesis would help. In any event, this hypothesis needs a change, and I'm not sure I should be the one to propose it. Chadwick?]*

E6. Flexible, real time modification of exports is ~~superior to~~ *more efficient than* other requirements (E/I ratio, direct export curtailments, VAMP, X2) ~~having the same effect~~ *intended to have positive influences on fish populations.*

F. OTHER ACTIONS AND FACTORS:

Actions other than water project-related actions in the Delta affect population levels of fish. Uncontrollable factors also have important effects.

General Hypothesis: Water project-related actions in the Delta have effects that are important to population levels of fish and important relative to other actions and factors affecting population levels. *[This General Hypothesis is not very clear, but I don't have a very good suggestion on re-stating it. I just think it needs a little work to be more clear.]*

Specific Hypotheses

F1. Introduced species have altered the *ecological* relationships *among native species and between these species and their habitats, including those governing* ~~between water project operations and~~ survival, *and* mortality.

F2. Introduced species have also changed the relationships between water project operations and these parameters, ~~or population,~~ but the relationships are still sound enough for management of water project operations *in ways which will have population-level benefits for target fish species.*

PUTTING WATER PROJECT ACTIONS IN THE DELTA IN PERSPECTIVE

The above hypotheses concern water project actions in the Delta and the effect of these actions on fish. Other actions can be taken to improve ~~the fishery~~ *fish populations.* These include water project-related actions upstream of the Delta (increasing stream flows, removing dams, controlling water temperature, etc.) They also include non-water project-related actions throughout the habitat range of species of interest (e.g., hatchery and harvest management, habitat improvements, predator control). In addition, factors not subject to control (e.g., climate-related changes) have important effects on Bay-Delta fish.

The importance of water project-related actions in the Delta should be compared to the importance of other actions and factors not subject to control for two reasons:

To determine how important water project-related actions in the Delta are in the larger context of fishery improvement.

To provide a basis for the Environmental Water Account to spend its resources most efficiently.

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Therefore, the technical teams should provide a quantitative comparison of the effects of water project-related actions in the Delta to the effects of other actions or factors affecting ~~the fishery~~ *fish populations*. This comparison need not be comprehensive (i.e., covering every possible action or factor). It should be sufficient to allow policy makers to answer the following two questions with respect to water project-related actions in the Delta:

In the overall scheme of things, will the action have effects that are worth the costs?

Are there actions other than water project-related actions in the Delta that could be carried out using Environmental Water Account resources that would provide greater benefit at less cost?

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